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Cover: A male Narrow-banded Awl, *Hasora khoda* (Hesperiidae: Coeliadinae). Occuring from New South Wales to central Queensland, this species flies at all times of the day, but usually at dusk and early morning. The larvae feed on *Wisteria* and *Callerya* (formerly *Millettia*). Awls are distributed from Africa and Madagascar to SE Asia and Australia. Many species are migratory. Their origin is obscure but their close relatives are the legume-feeding 'tailed skippers' (Eudaminae) of South America. They are a basal group of butterflies probably linked to Gondwana. Illustration by Andrew Atkins.

NOTES ON THE BIOLOGY OF *MERIMNA ATRATA* (GORY & LAPORTE) (COLEOPTERA: BUPRESTIDAE)

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Abstract

Notes are presented on the biology of *Merimna atrata* (Gory & Laporte). The larval food plant for a reared specimen in eastern Queensland was fire-killed *Baeckea frutescens* L. (Myrtaceae).

Introduction

Merimna atrata (Gory & Laporte) is the only species within the buprestid genus *Merimna* Saunders and is distributed throughout Australia (Bellamy 2002). It is unique within the family in being nocturnal but occasional specimens feed at blossom during the day. It is known for its habit of flying to lights and into fires, apparently attracted by heat. Hawkeswood and Peterson (1982) recorded it ovipositing into smouldering bark at the base of a eucalypt, *Eucalyptus* (*Corymbia*) *calophylla* R.Br. ex Lindl. (Myrtaceae) in Perth, WA, but this species' status as a food plant has not been confirmed (Hawkeswood 2007). Recent work has shown that *M. atrata* locates fires by infrared-sensitive sense organs on its abdomen (Schmitz *et al.* 2000).

The first observation of fire attraction in *M. atrata* was by H.M. Giles in Perth, as reported by Poulton (1916), who stated that 'its life history is unknown, but I think it is likely that the larvae feed in the roots of the burnt shrubs'. Recently, three final instar larvae were collected by the author 18 km north of Yepoon in central Queensland, with one being reared to adult.

Observations

On 18 September 2005, during a search for buprestid larvae in a small area of regrowth heath clean burnt during December 2003, several fire-killed stumps of *Baeckea frutescens* L. (Myrtaceae) were knocked out of the dry sand with the back of a tomahawk and dissected. The stumps were made up of numerous, very tightly interlocked segments, each of which supported a slender stem prior to being burnt. Considerable force had to be applied to split the segments apart. Termites had removed all bark and soft tissue from the outer surface and the remaining wood was very dry and extremely hard.

No larvae or evidence of larval activity were found within the stumps/roots during dissection but three separate larvae were found in loose sand after the stumps were unearthed. The large size, 35-40 mm, precluded a *Castiarina* species and another buprestid, *Temognatha obesissima* (Thomson), which occurs commonly in the area, was considered a possibility. One larva had been damaged and was discarded. Although buprestid larvae are difficult to rear once exposed, the two remaining larvae appeared mature and were placed on damp padded tissue, in small clear plastic boxes, in order to permit observation without disruption. The boxes were then shelved in darkness.

On 25 October 2005, a parasitic larva approximately 12 mm long was seen attached to the side of one of the buprestid larvae. The parasite was detached in an attempt to save the buprestid larva and boxed separately. Both larvae remained alive for some time but failed to pupate.

The remaining larva pupated on 29 October 2005 and an adult *Merimna atrata* emerged during the night of 13 November 2005. It had become apparent that it was not *T. obesissima* as expected when the white pupa darkened to black prior to emergence. Like the pupa, the adult lay on its dorsal surface and moved its legs for several days before turning right way up. It is retained in the author's collection.

Discussion

Buprestidae are considered to breed within the stems, roots or leaves of living or dead plants. Many small species are leaf miners. The larvae recorded here were unearthed in loose sand, with none found by dissecting the stumps, but it is not known whether they were free-living or were simply dislodged during the collection process. In December 2004, twelve months after the fire and following a heavy storm on the previous afternoon, *M. atrata* adults were common on the stems of low, green regrowth within the burnt area. If oviposition in this species only occurs in direct response to fire, as recorded by Hawkeswood and Peterson (1982), the adults observed might have been newly emerged after a life cycle of only one year with some, e.g. the three larvae collected, taking two or more years to complete development.

The wide distribution of *M. atrata* suggests that it uses a range of fire-killed timber other than *Baeckea frutescens*, which has a restricted habitat.

Acknowledgement

I thank Dr Rhonda Melzer (Environmental Protection Agency [EPA], Rockhampton) for assistance with plant identification.

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A NEW GEOGRAPHICAL RECORD FOR *ANISYNTA CYNONE* (HEWITSON) (LEPIDOPTERA: HESPERIIDAE: TRAPEZITINAE)

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Abstract

Torrington, on the Dutchman's Tableland in the extreme north of the New England region of New South Wales, is recorded as a new locality for *Anisynta cynone* (Hewitson). Specimens from this locality are discussed and illustrated.

Introduction

Anisynta cynone (Hewitson) is an endemic Australian skipper known from the Yorke Peninsula in South Australia to the lower Murray Valley in Victoria and Deniliquin in southwestern New South Wales, and from Gunnedah, Somerton, Mt Kaputar and Bolivia Hill in northeastern New South Wales (Braby 2000). Braby (2000) recognised only two named subspecies, the southern *A. c. cynone* and the northern *A. c. gunneda* L.E. Couchman. The latter subspecies is known with certainty only from Gunnedah and Somerton (Braby 2000), with specimens from Mt Kaputar (included by Common and Waterhouse 1981) considered to be distinct (Braby 2000, Sands and New 2002).

Braby (2000) also excluded the population at Bolivia Hill (36 km south of Tenterfield in the New England region of NSW) from *A. c. gunneda*. It appears to share characteristics with *Anisynta tillyardi* Waterhouse & Lyell (Braby 2000, D.P.A. Sands, J.F.R. Kerr and E.D. Edwards pers. comms) and might be part of a natural hybrid zone (Sands and New 2002).

Observations and discussion

During a field trip to Bolivia Hill in early April 2005, a single male resembling *A. cynone* was observed near the summit of that location. In April 2006, an unidentified species of HesperIIDae was observed near a drainage point adjacent to pastoral land on the nearby Dutchman's Tableland, which lies about 20 km to the west of Bolivia Hill. Three specimens (two males and one female), in poor condition, were collected at this location (Silent Grove Road, 1128 m, 4.0 km north of Torrington, 29°16'54"S, 151°41'08"E) in April 2007.

On 12 and 14 March 2008, two further visits were made to the Dutchman's Tableland locality. On both days weather conditions were ideal. A large number of *A. cynone* adults were observed and 26 collected (Figs 1-4).

The habitat of *A. cynone* at this locality is a section of unsealed road that passes through pastoral land. While the Dutchman's Tableland is well protected and under National Parks' control, this particular area is an exception. Surveying in the adjacent and pristine Torrington Conservation Park did not yield any observations or records of this skipper.

On occasions, some *Anisynta* Lower species may be abundant in areas that have been disturbed, although availability of snow-grass (*Poa* spp.) is a prerequisite. This newly reported occurrence is typical of a disturbed habitat. Adults appeared to originate from undulating, cleared grazing land on the high side of an unsealed road and flew along the roadside before settling on yellow flowers. Some forest is present on the lower side of the road.

This locality is significant due to the strength and abundance of the colony as well as its close proximity to the Queensland border, 22 km directly to the northwest. Here the species is well established and secure. A meeting with a landholder suggested there would not be changes to farming practices in the area in the foreseeable future.

The collected specimens show some variation in size and colouration. Average wingspan is 26 mm ($n = 16$) for males and 27 mm ($n = 10$) for females, close to those of *A. tillyardi*. The wing pattern is similar to that of specimens of *A. cynone* from the Mt Kaputar and Gunnedah localities (E.D. Edwards pers. comm.). As with the Mt Kaputar and Bolivia Hill populations, the subspecific status of these Dutchman's Tableland specimens is not certain and further taxonomic studies may be needed.



Figs 1-4. *Anisynta cynone* from the Dutchman's Tableland, NSW. (1-2) male upper and undersides; (3-4) female upper and undersides. (Scale bar = 10 mm).

Acknowledgements

All surveys in this area were conducted on NSW National Parks Scientific Licence number S 11996. Dr D.P.A. Sands examined the collected specimens. Mr E.D. Edwards (Australian National Insect Collection, Canberra) examined images and specimens and provided detailed comparison with the same species from other locations. The owner of 'Tungsten' provided insights on the settlement and history of Torrington and the Dutchman's Tableland. Geoff Thompson (Queensland Museum) skilfully prepared the figures.

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RANGE EXTENSIONS FOR TWO SPECIES OF LYCAENIDAE (LEPIDOPTERA) TO COFFS HARBOUR, NEW SOUTH WALES

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Abstract

Records of southern extensions of range are provided for *Hypochrysops digglesii* (Hewitson) and *Nacaduba kurava parma* Waterhouse & Lyell, collected in Coffs Harbour, New South Wales.

Introduction

During December 2007 and January 2008, two lycaenid butterfly species were captured at Sapphire Beach, Coffs Harbour, New South Wales. Both were represented by single specimens taken in a garden bordering the Orara East State Forest, at an altitude of 100 m and 2 km west of the coastline. Both were collected significantly further south than their previously reported southern limit.

New records

LYCAENIDAE

Hypochrysops digglesii (Hewitson)

One male, in freshly emerged condition, was collected on 26.xii.2007 at 0900h. This specimen was inconspicuous, rapidly circling and feeding from flowers of a large *Hibiscus* sp. at a height of 2 metres, in full sun. This record extends the known range of this species approximately 80 km further south than the previously reported locality of Grafton (Common and Waterhouse 1981, Braby 2000, 2004).

Nacaduba kurava parma Waterhouse & Lyell

One female, in freshly emerged condition, was collected on 27.i.2008 at 1500h. This specimen was observed resting 50 cm above the ground in the afternoon sun, with its wings outstretched, on a small *Murraya paniculata*. This record extends the known range of this species approximately 80 km further south than the previously reported locality of Grafton (Common and Waterhouse 1981, Braby 2000, 2004).

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RELATIONSHIPS OF THE SWALLOWTAIL 'GENERA' *AGEHANA* MATSUMURA, *CHILASA* MOORE AND *ELEPPONE* HANCOCK (LEPIDOPTERA: PAPILIONIDAE)

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Abstract

Three Old World groups of Papilionini with apparent New World ancestors are reviewed. The Chinese *Agehana* Matsumura is transferred from a subgenus of *Chilasa* Moore to a subgenus of *Pterourus* Scopoli. The Indo-Papuan *Chilasa* and Australian *Eleppone* Hancock are treated as sister-genera derived from ancestral *Heraclides* Hübner. Dispersal is suggested to be Beringian in *Pterourus* (*Agehana*) and Gondwanan in *Chilasa* and *Eleppone*.

Introduction

Papilio Linnaeus *sens. lat.* is a worldwide genus of some 200+ species of swallowtail butterflies. Hancock (1983) divided it into six genera (*Pterourus* Scopoli, *Heraclides* Hübner, *Eleppone* Hancock, *Chilasa* Moore, *Princeps* Hübner and *Papilio*) that are now [with the exception of *Chilasa*] generally regarded as subgenera (e.g. Häuser *et al.* 2005). Smith and Vane-Wright (2008) noted that a more detailed examination of individual species-groups might provide data enabling their monophyly to be tested and a more robust phylogenetic hypothesis to be produced.

Chilasa, *Eleppone* and *Agehana* Matsumura [placed by Hancock (1983) as a subgenus of *Chilasa*], include 14 species of Old World swallowtails that are apparently derived from New World ancestors (Hancock 1983). As such, they represent a small terminal group or groups that might help determine the status of their ancestral groups. Their relationships are reassessed below.

Wing shapes and patterns throughout these three groups have been so greatly modified by mimicry that they are completely unreliable as indicators of relationships. Hence, greater reliance must be placed on characters of the early stages and male genitalia. For the purposes of this study, the generic names recognised by Hancock (1983) are used below.

Agehana Matsumura

Agehana is an Oriental taxon of two closely related species: *A. elwesi* (Leech) from China and *A. maraho* (Shiraki & Sonan) from Taiwan. It was included within *Chilasa* by Igarashi (1976), placed as a subgenus of it by Hancock (1983) and regarded as a separate but closely related genus by Igarashi (1984). He *et al.* (1992) also treated it as a full genus. Miller (1987) did not include it in his study and it does not appear to have been a part of any molecular investigation.

Adults have exceptionally broad tails (uniquely enclosing two veins) and appear to be Batesian mimics of the distasteful troidine genus *Atrophaneura* Reakirt (Papilionidae) and/or the day-flying moth genus *Epicopeia* Westwood (Epicopeiidae) (Hancock 1983). Igarashi (1976) illustrated the

male genitalia. The valva has a broad clasper [= harpe] with a serrate apical lobe and a distinct apicoventral spine. Early stages were discussed and/or illustrated by Igarashi (1984: *maraho*) and He *et al.* (1992: both species).

Mature larvae are smooth, largely green above and blackish-brown below, with similarly dark markings on the prothorax, as a pair of metathoracic 'double eye-spots', as a narrow band along the posterior margin of the first abdominal segment, as a pair of subdorsal anterior spots or patches on the second abdominal segment and as a)(shaped pair of dark abdominal markings (viewed from above) which are separated dorsally but connect laterally with the dark lateroventral band; the 'eye-spots' are not connected by a dark band, there is a distinct series of blue abdominal spots below the spiracles and the osmeterium is white. Pupae are brown and relatively narrow but not stick-like; the head is truncate and the thoracic 'horn' is short and oblique. Larval food plants are *Liriodendron* (Magnoliaceae) for *A. elwesi* and *Sassafras* (Lauraceae) for *A. maraho* (Igarashi 1984).

The mature larvae of both species (He *et al.* 1992) are remarkably similar to those of *Pterourus* Scopoli (Tyler *et al.* 1994), retaining the)(shaped abdominal markings seen in subgenus *Pyrrhosticta* Butler (which often, but not always, connect dorsally in the latter taxon) and having the isolated metathoracic 'eye-spots' seen in subgenus *Pterourus* (which lacks the)(shaped abdominal markings). The shape of the abdominal markings, the dark lateroventral band and (especially) the series of blue subspiracular abdominal spots set the *Agehana* species apart from superficially similar larvae in the large, Old World genus *Princeps* [including the primitive *Pr. xuthus* (Linnaeus)] and are especially indicative of a close relationship with *Pterourus*. In *Princeps*, the lateroventral band is largely white and blue spots are absent. The eggs, pupae and larval food plants of *Agehana* are also similar to those of *Pterourus*. The male genitalia, especially the valva and clasper (Igarashi 1976), are very similar to those of subgenus *Pterourus* (Miller 1987, Tyler *et al.* 1994), particularly *Pt. esperanza* (Beutelspacher) (Beutelspacher 1975) from Mexico, which has *Pterourus*-like larvae (Tyler *et al.* 1994) and appears to be the most primitive species in that subgenus.

***Chilasa* Moore**

Chilasa is a largely SE Asian taxon extending as far eastwards as New Guinea and the Solomon Islands. Eleven species are recognised: *C. clytia* (Linnaeus), *C. paradoxa* (Zinken-Sommer), *C. veiovis* (Hewitson), *C. osmana* (Jumalon), *C. carolinensis* (Jumalon), *C. agestor* (Gray), *C. epycides* (Hewitson), *C. slateri* (Gray), *C. laglaizei* (Depuiset), *C. toboroi* (Ribbe) and *C. moeneri* (Aurivillius). It was treated as a distinct genus by Igarashi (1976, 1984) and by Hancock (1983). The former also included the South American *Heraclides anchisiades* (Esper) and its allies within *Chilasa*, while the latter arrangement (*i.e.* excluding *Heraclides*) has been widely (but not universally) adopted in recent years (*e.g.* by Häuser *et al.* 2005).

Adults often have a pale-spotted frons, thorax and abdomen and appear to be Batesian mimics of various danaines (Nymphalidae) or (in the Papuan *laglaizei* group) the day-flying moth genus *Alcides* Hübner (Uraniidae). The male genitalia are not uniform in shape. The clasper is either broad (e.g. *clytia*, *paradoxa*, *veiovis*, *agestor*, *epycides*) or narrow (*slateri*, *laglaizei* group); there is no apicoventral spine but a posteroventral spine is present in *C. paradoxa*. The aedeagus is strongly curved. Early stages were discussed and illustrated by Straatman (1975), Igarashi (1984) and Müller (2001) and have been illustrated in various faunal works.

Eggs are laid singly or in batches and larvae are accordingly either solitary (*clytia*, *agestor*) or gregarious (*epycides*, *slateri*, *laglaizei*, *toboroï*). Mature larvae are variable in appearance but are generally dark with pale spots or patches; the prothorax, mesothorax, metathorax and abdominal segments 1-9 are distinctly tuberculate (except in *C. epycides*). In the *laglaizei* group, mature larvae are banded with large, white lateral spots and the tubercles are reduced (absent on prothorax). Pupae are generally brown and stick-like, resembling a broken twig; the thoracic 'horn' is rudimentary and parallel with the body axis. In the *laglaizei* group the pupa is yellow and robust with the thoracic 'horn' vestigial. Known larval food plants are species of *Litsea*, *Cinnamomum* and *Persea* (Lauraceae).

The dark, tuberculate mature larva and shape of the pupal thoracic 'horn' are likely to be homologous with those seen in several *Heraclides* species, although the pale larval markings are possibly independently derived. Solitary and gregarious larvae occur in both *Chilasa* and *Heraclides*. Igarashi (1976, 1984) also noted a close relationship between *Chilasa* and *Heraclides* based on their early stages and male genitalia, specifically the broad clasper although the similarities appear largely superficial and there are no apical or medioventral spines present in *Chilasa*.

***Eleppone* Hancock**

Eleppone was proposed for the sole Australian species *Papilio anactus* W.S. Macleay (Hancock 1979, 1983). It is currently regarded as a subgenus of *Papilio* (e.g. by Häuser *et al.* 2005), although Igarashi (1976, 1984) and Hancock (1983) had regarded it as either a part of or the sister-genus of *Chilasa*.

Adults have a pale-spotted frons, thorax and abdomen and, in both appearance and behaviour (A.G. Orr, pers. comm.), appear to be effective Batesian mimics of the distasteful troidine *Cressida cressida* (Fabricius). The male genitalia were illustrated by Miller (1987); the clasper is broad with a posteroventral spine and the aedeagus is strongly curved. Early stages were illustrated by Fisher (1978).

Eggs are laid singly and are unusually small (A.G. Orr, pers. comm.). Mature larvae are dark with pale spots and patches; the prothorax, mesothorax,

metathorax and abdominal segments 1-9 are distinctly tuberculate. Pupae are generally a variegated grey, brown and green, relatively straight and stick-like in shape but with the head not truncate; the thoracic 'horn' is rudimentary and parallel with the body axis. Larval food plants are various species of Rutaceae, including cultivated *Citrus*.

The early stages and male genitalia indicate a close relationship between *Eleppone* and *Chilasa* (Igarashi 1976, Hancock 1983), particularly the mature larval morphology, the shape of the pupal thoracic 'horn', the posteroventral spine on the male clasper and the curved aedeagus. However, the slightly curved pupa with a non-truncate head and the rutaceous larval food plants also indicate a close relationship with *Heraclides*, these characters being modified in *Chilasa*.

Discussion

The species currently included in *Agehana* do not appear to be as closely allied to those placed in *Chilasa* as previously believed; the early stages in particular are very different. The true relationships of the *Agehana* species appear to be with the American genus *Pterourus* and, wing shape and pattern aside, there do not appear to be any differences significant enough to recognise it as a separate genus. This, together with the apparent intermediate nature of the mature larva, between subgenera *Pterourus* and *Pyrrhosticta*, suggest that a subgeneric placement of *Pterourus* (*Agehana*) is the most appropriate, with subgenus *Pterourus* as its most likely sister-group.

The present distribution of the *Agehana* species in China and Taiwan appears to be a result of Beringian dispersal from a North American *Pterourus* (*Pterourus*) ancestor, possibly now represented by *Pt. esperanza*, which subsequently radiated throughout Central and North America as the *glaucus* and *troilus* groups of Hancock (1983). This dispersal appears to have occurred after the *Pterourus*-*Pyrrhosticta* split, which saw the latter subgenus radiate widely throughout South and Central America. Beringian dispersal from the Palearctic to North America has evidently occurred in other papilionids, such as *Parnassius* Latreille and the *Papilio machaon* group, so movement in the other direction is not especially surprising.

Removal of the *Agehana* species from *Chilasa* enables the latter genus to be more rigidly defined and larval and genitalic similarities within both it and *Heraclides* (see Tyler *et al.* 1994) suggest that each genus is monophyletic. The relationship is thus one of common ancestry rather than a derivation of *Chilasa* from within *Heraclides*. Its present distribution in the Indo-Australian region is undoubtedly a result of Gondwanan dispersal from South America and this appears to have been accompanied by a switch in larval food plants from Rutaceae to Lauraceae.

Current distribution of the various *Chilasa* species closely mirrors that of the *Trogonoptera*-*Troides*-*Ornithoptera* lineage in tribe Troidini (see Hancock

2007), suggesting a possible centre of origin in the SE Asian (Sundaland) block rather than the Greater Indian block. The fact that SE Asian *Chilasa* species mimic danaines rather than troidines in the *Atrophaneura* group of genera [which appear to be primitively associated with the Greater Indian block: Hancock 2007] also suggests that they evolved apart. Dispersal eastwards to New Guinea and the Solomon Islands (as in the case of *Ornithoptera* Boisduval) is supported by the apparently derived nature of the *laglaizei* group, in which the larvae and pupae are highly modified.

Specific relationships within *Chilasa* are difficult to determine. Apart from the distinctive *laglaizei* group (*C. laglaizei*, *C. moerleri*, *C. toboroi*), the male genitalia (where known) do not show distinct patterns of similarity and life history details are unknown for several species. In the polymorphic *C. paradoxa* and *C. clytia* the hindwing vein Rs arises near the base of the discal cell, in *C. veiovis*, *C. osmana* and *C. carolinensis* it arises centrally and in the other species it arises closer to the apex of the cell. *C. veiovis* shows the large size and apically produced forewings typical of many Sulawesi swallowtails and has an uncertain mimetic association. Its hind wing retains the tooth to vein M₃ and position of vein Rs seen in *Eleppone anactus* and it is possibly a relict representative of the ancestral species.

Given its apparently intermediate position between *Heraclides* and *Chilasa*, the Australian *Eleppone* is best retained as a separate genus, sister to (but more primitive than) the Indo-Papuan genus *Chilasa*. Like the latter genus, it also appears to be a result of Gondwanan dispersal from a South American ancestor and its more primitive position suggests that *Chilasa* reached the Sundaland block via Australia. At some time in the past, *E. anactus* was presumably restricted to eastern Australia, developing its mimetic pattern following an overlap with *Cressida cressida*. Its present distribution beyond the range of the latter is presumably a result of *Citrus* cultivation in modern times. Its absence from most of northern Australia suggests that (unlike *C. cressida*: Hancock 2007) it is not an invader from the north. Unfortunately, this taxon was not considered by de Jong (2003) in his study of potential Gondwanan relicts but its apparent relationship with *Chilasa* and *Heraclides* suggests that a Gondwanan ancestry is likely.

Eleppone is also likely to be contemporaneous with the endemic Australian genus *Protographium* Munroe [tribe Leptocircini]. Male genitalic characters (particularly the shape of the clasper) show that American species included in the latter genus by Tyler *et al.* (1994) are better placed in *Protesilaus* Swainson [= *Mimoides* Brown, which grades into it via *P. asiis* (Fabricius) and *P. agesilaus* (Guérin-Méneville)] or *Eurytides* Hübner (see Hancock 1983). *Eurytides bellerophon* (Dalman) was transferred from *Protesilaus* by Tyler *et al.* (1994), while *Iphiclides* Hübner, *Graphium* Scopoli and *Lamproptera* Gray (see Miller 1987) appear to belong to a separate, Laurasian radiation (*c.f.* *Papilio* + *Princeps*).

The above discussion suggests that the current arrangement of recognising *Chilasa* as a separate genus and including *Pterourus*, *Heraclides* and *Eleppone* as subgenera of *Papilio* (e.g. Häuser *et al.* 2005) is untenable, since it results in a paraphyletic classification. Either all must be treated as subgenera of the 'supergenus' *Papilio sens. lat.* (essentially following Miller 1987), or *Pterourus*, *Heraclides* and *Eleppone* must also be treated as distinct genera, as suggested by Hancock (1983). The latter arrangement enables a clearer expression of the diversity and relationships of the 200+ species of 'fluted' swallowtails by way of further subgeneric divisions.

Acknowledgement

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THE GENUS *PAMBORUS* LATREILLE (COLEOPTERA: CARABIDAE) IN THE SLOANE COLLECTION AND ITS IMPORTANCE FOR CURRENT TAXONOMY

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Abstract

We report on the holdings of *Pamborus* Latreille in the Sloane Collection preserved in the Australian National Insect Collection, Canberra. The collection consists of ten species with 55 individuals. We point out the importance of the collection in current taxonomy and biogeography of the genus. A lectotype is designated for *Pamborus elegans* Sloane.

Introduction

The genus *Pamborus* Latreille, 1812 is a group of flightless ground beetles endemic to the eastern coastal region from southern New South Wales (NSW) to northern Queensland (Qld) in Australia. Bänninger (1940) was the last to revise this genus, although Darlington (1961) described four additional species in this genus from the subtropical and tropical regions of Qld. As a result, Moore *et al.* (1987) recognized 12 species in the genus *Pamborus*. However, species diversity, phylogenetic relationships and distributional ranges of the genus have not been sufficiently understood and a comprehensive taxonomic revision has been needed. The senior author and his colleagues have attempted to revise this genus by employing novel types of data: genital morphology (internal sac of male intromittent organ) and molecular phylogenetics (mitochondrial and nuclear DNA sequences) (Sota *et al.* 2005, Takami and Sota 2006). Currently, the genus *Pamborus* comprises 16 species, although our revisional studies are continuing.

Thomas Gibson Sloane (1858-1932) was a sheep grazier and entomologist who devoted his life to the taxonomy of Australian Carabidae (ground beetles), including the Cicindelinae (tiger beetles). He later became a world authority on Carabidae (Walsh 1988). After his death, his collection of Australian carabids was donated to the then Commonwealth Council for Scientific and Industrial Research (CSIR) in 1932 and is now preserved in the Australian National Insect Collection (ANIC), Canberra. His collection of carabids was thorough, being described as 'the only extant collection of Australian Caraboidea ever put together by a specialist recognized the world over' (Walsh 1988). However, by the time it was donated to CSIR it had suffered badly due to *Anthrenus* attack, with perhaps only 50% of specimens remaining intact.

In the course of our revisional studies on the genus *Pamborus*, we examined the specimens in the Sloane Collection and obtained important information for the taxonomy of the genus. With respect to the locality data, we discuss the scientific values of the collection for clarifying distributional ranges of the species. Sloane (1915) did not designate a holotype for *P. elegans* Sloane in his original description, which was based on two female specimens regarded as syntypes by Moore *et al.* (1987). A lectotype for the species *P. elegans* (Fig. 1) is designated herein to stabilize the nomenclature (International Code of Zoological Nomenclature (ICZN) article 74).

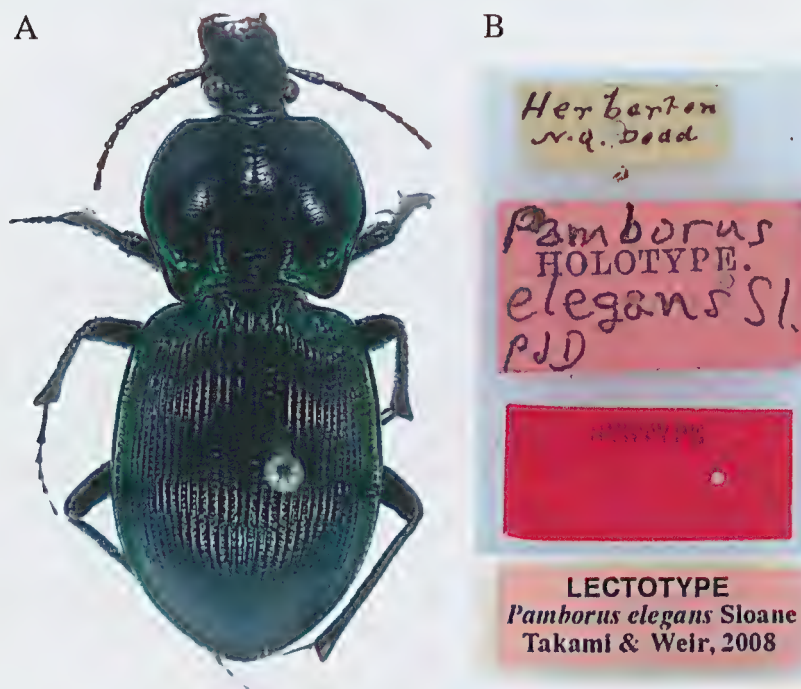


Fig. 1. The lectotype of *Pamborus elegans* Sloane: (A) dorsal habitus; (B) labels attached.

Materials and methods

When the collection was acquired by CSIR in 1932, some of the specimens were seriously damaged. Specimens damaged beyond recognition were not included in this study. We selected well-preserved, intact specimens from Sloane's original wooden cabinet drawers that are currently stored in steel drawers. We determined these based on external and genital (if available) morphologies in accordance with the current taxonomic system (Moore *et al.*

1987, Takami and Sota 2006). We have attempted to clarify the localities from the labels.

Pamborus elegans Sloane

(Fig. 1)

Pamborus elegans Sloane, 1915: 438-439. Type locality: 'Herberton District, southward from Atherton, Queensland'.

Pamborus elegans: Bänninger, 1940: 204; Darlington, 1961: 2, 5-6; Moore *et al.*, 1987: 63.

Material examined. Lectotype ♀ (here designated) of *P. elegans* Sloane: labelled 'Herberton N.Q. Dodd', 'HOLOTYPE. *Pamborus elegans* Sl. PJD', 'SYNTYPE', and 'LECTOTYPE *Pamborus elegans* Sloane Takami & Weir, 2008', in ANIC.

Comments. Although this specimen was labelled as 'HOLOTYPE' by Darlington (PJD, above), there has been no designation of holotype or lectotype in Sloane (1915) or Darlington (1961). Since Sloane (1915) described this species based on two female syntypes, the other syntype becomes a paralectotype on the present designation of the lectotype, even though it was not found in the collection.

Results and discussion

The genus *Pamborus* in the Sloane Collection consists of 10 species with 55 individuals in total (Table 1). This covers 10 of the 16 currently known species (Moore *et al.* 1987, Takami and Sota 2006). Six of the eight species known to Sloane (at the first third of the 20th century) are involved: *P. alternans* Latreille, 1812, *P. guerinii* Gory, 1831, *P. macleayi* Laporte, 1867, *P. brisbanensis* Laporte, 1867, *P. pradierei* Chaudoir, 1869, and *P. elegans* Sloane, 1915 (Table 1). The two species not present (*P. viridis* Gory, 1836 and *P. opacus* Géhin, 1885) are either rare or taxonomically problematic (only the type is known) respectively (Takami and Sota 2006; see below about the identity of *P. viridis*).

Although the total number of individuals is small, specimens are from a wide distributional range (Fig. 2). This reflects Sloane's enthusiasm for collecting and studying this group of beetles, which resulted in his revisional study on the genus (Sloane 1905) and the description of *P. elegans* from Herberton on the Atherton Tableland, northern Qld (Sloane 1915). Since *P. elegans* has never been collected from the type locality after his record (Bänninger 1940, Darlington 1961), the specimen in his collection (lectotype, present designation) is quite important for clarifying the distributional range of this species. The label of the lectotype of *P. elegans* (Fig. 1B) shows that it was collected by Frederick Parkhurst Dodd. As pointed out by Monteith (1991), Dodd's own account of his collecting trip in 1910-1911 (Dodd 1911) shows that his 'Herberton' material was collected in the moist forests on the Evelyn Tableland, 15 km SSE of the dry locality of Herberton. Dodd mentioned taking 'a handsome *Pamborus*', which probably refers to *P. elegans*.

Table 1. List of identifiable *Pamborus* species from Sloane Collection incorporated into the Australian National Insect Collection, CSIRO, Canberra (ANIC).

Species [total number of specimens]	Locality	Number
<i>Pamborus alternans</i> Latreille, 1812 [18]	Bellinger River, NSW	1
	Burrawang, NSW	2
	Eccleston, NSW	3
	Ourimbah, NSW	1
	Bunya Mts, Qld	2
	Goodna, Qld	1
	Mt Tamborine, Qld	4
	locality unclear	3
	without locality	1
<i>Pamborus brisbanensis</i> Laporte, 1867 [1]	Byfield, Qld	1
<i>Pamborus elegans</i> Sloane, 1905 [1]	Herberton, Qld ¹	1
<i>Pamborus guerinii</i> Gory, 1831 [13]	Acacia Creek, NSW	1
	Bellingen, NSW	1
	Clarence River, NSW	1
	Dorrigo, NSW	4
	NSW/Qld	1
	Qld	2
	locality unclear	1
	without locality	2
<i>Pamborus macleayi</i> Laporte, 1867 [5]	Clarence River, NSW ²	2
	Richmond River, NSW	2
	locality unclear	1
<i>Pamborus monteithi</i> Takami & Sota, 2006 [1]	Burnett River, Qld	1
<i>Pamborus moorei</i> Takami & Sota, 2006 [4]	Guyra, NSW	1
	Orange, NSW	1
	Dalveen, Qld	2
<i>Pamborus pradierii</i> Chaudoir, 1869 [5]	Dorrigo, NSW	3
	Eccleston, NSW	1
	without locality	1
<i>Pamborus subtropicus</i> Darlington, 1961 [4]	Acacia Creek, NSW	1
	Rockhampton, Qld	1
	Yeppoon, Qld	1
	locality unclear	1
<i>Pamborus tropicus</i> Darlington, 1961 [3]	Kuranda, Qld	3

¹ Lectotype, present designation; ² type locality.

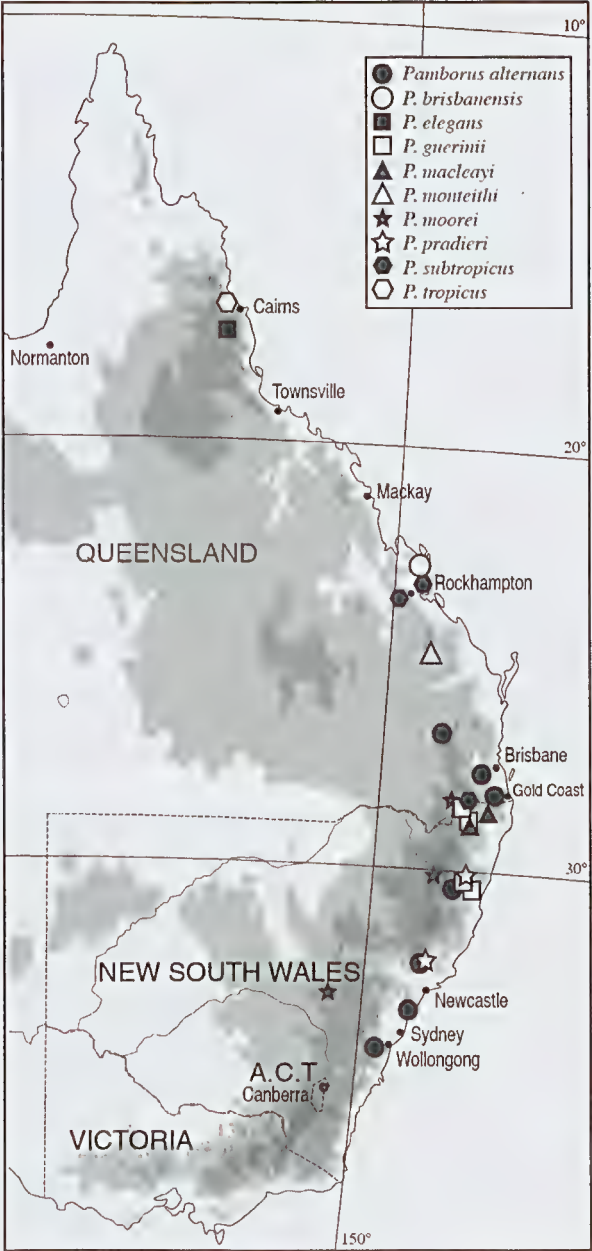


Fig. 2. Localities of *Pamborus* specimens in the Sloane Collection.

The Sloane collection contains four species that were undescribed at that time: *P. subtropicus* Darlington, 1961, *P. tropicus* Darlington, 1961, *P. moorei* Takami & Sota, 2006 and *P. monteithi* Takami & Sota, 2006 (Table 1). Sloane did not describe these species (Sloane 1905, 1915), probably because they are difficult to recognize on the basis of their external morphologies. These species have been confused with *P. viridis* or its related species because they all share greenish elytra with the costae almost continuous to the apex. They were recognized only very recently using male genital morphology and/or DNA sequence data (Sota *et al.* 2005, Takami and Sota 2006).

We could not find *P. opacus* in the collection, although it was listed by Sloane (1905) (but this may be *P. euopacus* with respect to its locality presented in the literature; see also Takami and Sota 2006). The specimen(s) of this species might be lost due to damage and, unfortunately, we could not obtain any information from the broken parts of the beetles.

Of the four 'undescribed' species collected by Sloane, *P. moorei* was recently described from Wollomombi, NSW and was assumed to be widespread in northern NSW (Takami and Sota 2006). This idea is supported by Sloane's locality data for this species in the collection (Table 1, Fig. 2): from Orange, NSW to the border area between NSW and Qld. Recently, we also confirmed this distribution pattern based on an examination of specimens of *P. moorei* in the Queensland Museum (Takami and Monteith, unpublished data). '*Pamborus viridis*' presented in the list of Sloane (1905) may correspond to *P. moorei*, because these two species have been confused until recently (Takami and Sota 2006) and we could not find true *P. viridis* in the collection.

Pamborus monteithi is another 'undescribed' species found in the Sloane Collection, which has been known only from Kroombit Tops, Qld (Monteith 1986, Takami and Sota 2006, Takami and Monteith, unpublished data). This species is conspicuous in its large size, brilliant colour and strongly hooked apex of the aedeagus (Takami and Sota 2006). The single male specimen in the collection is labelled from Burnett River, Qld, which is a new distribution record for this species (Table 1). Although detailed locality of collection is unclear, it may be an upper region of this river system, some tributaries of which reach to the southern foot of Kroombit Tops. Thus, the specimen of *P. monteithi* in the collection revealed that this species might have a wider distributional range than known previously.

The present list of the genus *Pamborus* in the Sloane Collection indicates not only its historical value, but also its importance in the taxonomy of the genus as discussed above. Data from historical collecting localities are quite important especially in flightless insects with low dispersal ability, which are likely to show conspicuous geographical variation and local extinction, possibly due to recent anthropological disturbance. The Sloane Collection

allows us to turn our thoughts to a century ago and helps current entomologists better understand the diversity of this group.

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NEW RECORDS OF BUTTERFLIES (LEPIDOPTERA) FROM THE PORT MACQUARIE AREA, NEW SOUTH WALES

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Abstract

Southern range extensions are provided for *Doleschallia bisaltide australis* C. & R. Felder, *Euploea tulliolus tulliolus* (Fabricius) and *Euchrysops cnejus cnidus* Waterhouse & Lyell, together with additional records of *Argynnis cyrila* Waterhouse & Lyell and *Zizula hylax attenuata* (Lucas) from the mid-north coast and hinterland of New South Wales.

Introduction

Braby (2000) and Common and Waterhouse (1981) recorded the distributions of various eastern Australian butterfly species as extending from the Queensland tropics to the north coast of New South Wales. Preserved areas of rainforest and high altitude forest on the mid-north coast of NSW, in particular near Port Macquarie, might be able to support species dependent on these environments, either as remnant populations or during southern population movements during suitable climatic periods. Between 2004 and 2008, several butterfly species were newly recorded in the area.

New records and observations

NYMPHALIDAE

Doleschallia bisaltide australis C. & R. Felder, 1867

Three adults were observed flying in littoral rainforest at Miners Beach in Sea Acres Nature Reserve, Port Macquarie, in February 2006. They were in varying degrees of wear and a further, fresh individual was observed in the same area on 12 March 2006. On 16 January 2007, an adult was observed along Stoney Creek Road at Middle Brother National Park, near Laurieton. A further adult was observed at Miners Beach on 26 September 2007. The distance between these sightings is 33 km. On 10 April 2008, a late instar larva was collected at the first author's home in Wauchope (located between the previous two sightings), feeding on *Pseuderanthemum variabile* (R. Br.) Radlk. (Acanthaceae). It pupated on 21 April and the adult [in A. Moore collection] emerged 29 days later on 19 May. The southern range limit for this species was previously recorded as Clarence River near Grafton (Braby 2000, Common and Waterhouse 1981) and these observations represent a range extension of approximately 200 km to the south. It is possible that this species was imported to the area on nursery stock, but the observations have all been in remnant rainforest and at all locations, including A. Moore's home, the larval food plant is native to the area. At Middle Brother NP, the location is not close to any dwellings. *D. b. australis* appears to be established in this area. The food plant *P. variabile* occurs as far south as Bega in southern NSW (NSW Flora Online 2008).

Euploea tulliolus tulliolus (Fabricius, 1793)

This species was observed, possibly ovipositing, in littoral rainforest at Miners Beach in Sea Acres Nature Reserve, Port Macquarie, on 12 March 2006. The previously recorded southern range limit for this species was Urunga (Common and Waterhouse 1981) and this new record extends the range 104 km to the south, although establishment is not confirmed.

Argynnis cyrila Waterhouse & Lyell, 1914

Specimens, including mating pairs and ovipositing females, were observed in large numbers at the summit of North Brother Mountain on 19-21 September 2007. Both sexes were also observed at Honeysuckle Rest Area in Barrington Tops National Park on 12 October 2007, confirming a previous sighting by Russell Mayo. Braby (2000) inferred a discontinuous distribution that corresponded with the data points in Dunn and Dunn (1991). The current observations provide new data points for previously recorded gaps in the known distribution.

LYCAENIDAE

Euchrysops cnejus cnidus Waterhouse & Lyell, 1914

A fresh adult male and female were collected at Forbes River, Birdwood on 25 March 2004, flying with *Everes lacturnus australis* Couchman. The southern range limit for this species was previously listed as Coffs Harbour (Braby 2000) and near Guyra (Dunn and Dunn 1991). This record extends the southern range limit by 140 km.

Zizula hylax attenuata (Lucas, 1890)

Glen Innes is the listed southern limit for this species, with occasional sightings recorded at Denman, Wingham and Sydney (Dunn and Dunn 1991). Three adults were collected at Forbes River, Birdwood on 25 March 2004, further suggesting that this species' range is spreading southwards.

Acknowledgement

We are grateful to Russell Mayo for his advice in compiling the manuscript.

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A LARVAL FOOD PLANT FOR *ATTEVA ALBIGUTTATA* (ZELLER) (LEPIDOPTERA: YPONOMEUTIDAE: ATTEVINAE)

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Abstract

An undescribed and endangered species of *Quassia* (family Simaroubaceae) is recorded as a larval food plant for *Atteva albiguttata* (Zeller). Descriptions of the final instar larva and pupa are provided, together with a discussion on potential food plant range and mimicry.

Introduction

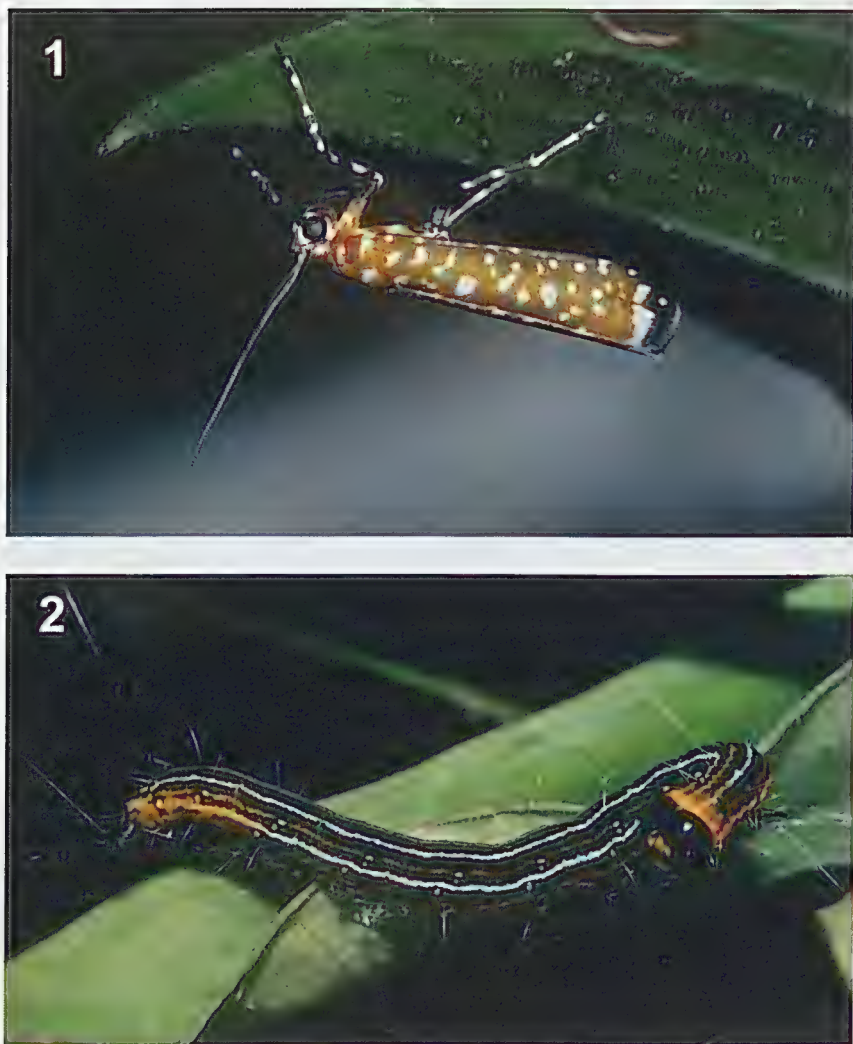
In March 2007, the primary author received an enquiry from J. Couper about the identity of moth larvae that were damaging an undescribed species of *Quassia*, the Moonee Quassia, *Quassia* sp. Moonee Creek (J. King s.n., Nov 1949) NSW Herbarium (Family Simaroubaceae) (APNI 2008). The Moonee Quassia is restricted to the Moonee Creek - Timbertop area north of Coffs Harbour, New South Wales (PlantNET 2007) and has received targeted investment funding under the Natural Heritage Trust and other programs (for further details see Mathews and Couper 2007). Due to the limited distribution of this plant, there is concern that the moth could have a deleterious effect on plant populations by slowing their growth and possibly decreasing seed production. Four pupae were supplied in March 2007, from which adults subsequently emerged. These were identified as the yponomeutid *Atteva albiguttata* (Zeller, 1873) (Fig. 1). Additional material was made available in January 2008 and the following brief descriptions of the larval and pupal stages were made, along with some life history observations.

Material examined

NEW SOUTH WALES: 2 ♂♂, 1 ♀, emerged 25.iii.2007 from 4 pupae collected 15.iii.2007, Maccues Rd, Moonee Beach, 30°12'29"S, 153°08'44"E, J. Couper; 6 late instar larvae, 15.i.2008, same locality and collector. Adult specimens are stored in the Australian Museum, Sydney.

Immature stages and life history

Final instar larva (Fig. 2). Elongate, approx. 30 mm long, anteclypeus pale translucent yellow, frontoclypeus bright lemon yellow, adfrontal region flanking frontoclypeus cream, indistinct cream marking dorsal to eyes, basal segment of antenna and labrum dirty cream, remainder of head glossy black, sutures cream. Ground colour of body segments dull dark chocolate-brown. Anterior prothorax and prothoracic shield bright yellow; pattern of subsequent thoracic segments gradually discernable on posterior dorsal region of segment. Ventrolateral regions of meso- and metathoracic segments bright yellow ventral from spiracles, with dark brown markings dorsad of



Figs 1-2. *Atteva albiguttata*. (1) freshly emerged adult male; (2) late instar larva in webbing on Moonee Quassia. Photos by D. Britton.

legs. Coxae cream and black, distal segments of legs glossy black. Longitudinal irregular lines running from prothorax to abdominal segment 10 as follows: faint dorsal and two strong dorsolateral lines level with dorsal setae cream, line level with subdorsal setae bright yellow, line ventral to spiracles cream, well developed; line level with subventral setae thin, bright



Figs 3-4. *Atteva alboguttata* pupa. (3) lateral view; (4) dorsal view, suspended in webbing on Moonee Quassia. Photos by D. Britton (3) or J. Couper (4).

yellow; ventral line cream, well developed; all of the above cream lines gradually becoming yellow at prothoracic and abdominal segments posterior to abdominal segment 7. Setae white, erect and very long.

Pupa (Figs 3-4). Elongate, 11 to 13 mm long, retaining larval colouration. Anterior margin of frontoclypeus with a pair of short acute projections level

and mesad of antennal bases. Eyes banded black, brown and cream. Antennae dark brown with bases cream. Prothorax mostly bright yellow, a pair of minute white setae on dorsal posterior surface. Wing covers light brown with white longitudinal streaks, wingtip of forewing reaching ventral posterior region of abdominal segment 5; base of wing covers with a large yellow spot. Abdominal spiracles dark red, visible from segments 3 to 8, absent from segments 9-10. Ground colour of abdomen honey-brown for segments 1-5, becoming darker brown for segments 6-8; longitudinal stripes as in larvae but all coloured cream and only dorsal stripes visible on segments 9-10; both segments 9 and 10 bright yellow anteriorly and black with an irregular anterior margin posteriorly. Cremaster strongly sclerotised, spatulate and square when viewed dorsally and with two pairs of very stout curved setae on each posterior angle.

Life history. Larvae form loose webbing around branchlets of the food plant, where they fed on growing tips, young growth and flower buds. Pupae remain suspended in the larval webbing on the food plant (Fig. 4). Duration of the pupal stage is approximately 12-14 days. Observations indicate that immature stages are present on the food plant in the Moonee Creek region from October to April, with webbing apparent by November when the plants begin to bud. The last larvae are present in late April. Details of oviposition behaviour and egg numbers are yet to be obtained.

Discussion

The genus *Atteva* Walker has a pantropical distribution, with more than 50 species currently described (Dugdale *et al.* 1999). The majority of published larval food plant records are plant species from the family Simaroubaceae, although plants in the families Leguminosae, Burseraceae, Santalaceae, Araliaceae, Lauraceae and Meliaceae are also utilised by some species (Dugdale *et al.* 1999, Robinson *et al.* 2008). For the four known Australian species (Nielsen *et al.* 1996), the only published food plant record is for *A. niphocosma* Turner, 1903, which has been recorded feeding on Pencil Cedar *Polyscias murrayi* (F.Muell.) Harms (Araliaceae) (V.J. Robinson, in Common 1990). The observation of *A. albiguttata* feeding on the Moonee Quassia is significant in that it indicates that at least one Australian *Atteva* species has retained what seems to be a strong co-evolutionary association between this moth genus and the Simaroubaceae.

Adult specimens held in the Australian Museum and Australian National Insect Collection indicate that *A. albiguttata* occurs in coastal regions from Tuncurry in New South Wales north to Mt Bellenden Ker in northern Queensland. This raises the question as to what range of food plants are utilised by *A. albiguttata*. The Australian Simaroubaceae consists of four genera (Hewson 1985) containing at least thirteen indigenous species, many of which are yet to be formally described, as well as the introduced noxious weed species *Ailanthus altissima* (Mill.) Swingle (Tree of Heaven) (APNI

2008, Guymner 2007). Given the environmental significance of *A. altissima* it is unlikely that damage by *A. albiguttata* would have been overlooked, so it is unlikely to be another food plant, although native species of *Ailanthus* may be. Most of the indigenous species of Simaroubaceae in Australia have restricted geographical distributions; this is reflected in two species of *Quassia* being listed as endangered and vulnerable under Commonwealth legislation, plus eight species which are still awaiting formal botanical description. Only two species of *Quassia* are known to occur in New South Wales and both have highly restricted distributions (PlantNet 2007, Floyd 2008). *A. albiguttata* has a broader known distribution than known for indigenous Simaroubaceae, which strongly suggests that there are as yet unknown alternative food plants for *A. albiguttata* from other plant families.

The Moonee Quassia is endemic to the NE coast of NSW and is currently known from 18 locations between Moonee Beach and McCraes Knob (east of Ulmarra) (Mathews and Couper 2007). It is a small tree that grows in coastal wet sclerophyll forest, reaching 2 m in height. It is currently listed as threatened, due to low numbers of plants in each discrete population, weed infestation, grazing and fire (Department of Environment and Conservation 2005) and is listed as 'Endangered' under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and the NSW *Threatened Species Conservation Act 1995*. The impact of *A. albiguttata* on the reproduction and health of Moonee Quassia plants has not yet been quantified. Given the apparently strong co-evolutionary association of *Atteva* spp. with plants in the family Simaroubaceae, it seems likely that the Moonee Quassia has evolved in association with this insect herbivore. Further studies of caterpillar herbivory would be useful in assessing this issue.

The apparently aposematic colouration of adults, larvae and pupae and the apparent lack of concealment of larvae and pupae suggest that this species may be distasteful to potential predators. Some aposematic herbivorous insects are thought to derive defensive chemicals from secondary compounds present in their food plants (Brower 1984). Knowledge of the plant chemistry of species in the Simaroubaceae may allow predictions as to any potential alternative food plants for *A. albiguttata*. *Quassia* spp. and other Simaroubaceae contain bitter compounds classified as quassinoids. Many of these compounds have been isolated, identified and laboratory tested *in vivo* and *in vitro*. They have been found to have antitumor, antimalarial, antiviral, anti-inflammatory, antifeedant, insecticidal, amoebicidal, antiulcer and herbicidal activities, but their widespread application in human and livestock medicine has been inhibited by their toxicity (Guo *et al.* 2005). It is possible that *A. albiguttata* and other *Atteva* species are sequestering these chemicals for defensive purposes. *Atteva* might be mimics of other insects that are distasteful and have similar colouration, in which case food plant choice may not be important. Conversely, they might have more complex mimicry associations with similarly coloured, tasteful or distasteful insects, in which

case a better understanding of any potential benefits gained from food plant selection may be obtained from further studies.

Acknowledgement

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THE FIRST RECORD OF AN AMYCTERINE WEEVIL (COLEOPTERA: CURCULIONIDAE: AMYCTERINAE) FEEDING ON ORCHIDACEAE

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Abstract

Tetralophus sculpturatus Waterhouse is reported feeding on sun orchids (*Thelymitra* J.R. Forst. & G. Forst.), the first record of amycterine weevils feeding on Orchidaceae.

Introduction

Until Howden (1986) published host records for ten genera of Amycterinae, little was known concerning larval and adult food sources of these diverse and endemic Australian weevils. Previous researchers had noted adult food plants but understood little in regard to larval hosts. Howden's (1986) studies revealed that most, if not all, amycterines feed on monocotyledons (plant classification here follows APG II (2003) in its widest sense), mainly Poales [especially Poaceae, but also Cyperaceae (*Lepidosperma*), Ecdiocoleaceae (*Ecdiocolea*) and Restionaceae (*Lepidobolus*)] and Asparagales [Asparagaceae *sensu lato* (*Dichopogon*, *Lomandra*) and Xanthorrhoeaceae *sensu lato* (*Bulbine*, *Dianella*, *Stypandra*, *Xanthorrhoea*)]. All records of amycterines from eudicot groups were for adults only (*Acacia*, the myrtaceous shrubs *Melaleuca* and *Leptospermum* and several genera of Papilionaceae) and almost certainly do not represent real (larval) hosts (Howden 1986).

Given the records of amycterines feeding on Asparagales (to which the family Orchidaceae belongs), including soft lilies like *Dichopogon* and *Bulbine* (Howden 1986, May 1994), it is surprising there are no published records from orchids, especially given the attention orchid biology receives from professional and amateur botanists. Here I report four independent records of *Tetralophus sculpturatus* Waterhouse (Fig. 1) feeding on the foliage of a sun orchid, *Thelymitra* J.R. Forst. & G. Forst. – probably a member of the *Thelymitra pauciflora* R. Br. group. These are the first confirmed host records for *Tetralophus* Waterhouse and of any amycterine weevils feeding on orchids. *Tetralophus* contains only one other species, *T. excursus* Pascoe, also occurring in southeastern Australia. Zimmerman (1993), noting that '*Tetralophus* species are extraordinarily and confusingly variable', synonymised the third previously recognized species, *T. incanus* Pascoe, with *T. sculpturatus* Waterhouse. Examination of material in the Museum of Victoria revealed a specimen of *T. sculpturatus*, without locality information, but with the collection data 'found in flower of orchids. W.K. 9.94'. These data are unclear, however, as to whether or not the individual was feeding on the plant and also give no indication as to the identity of the orchid genus.

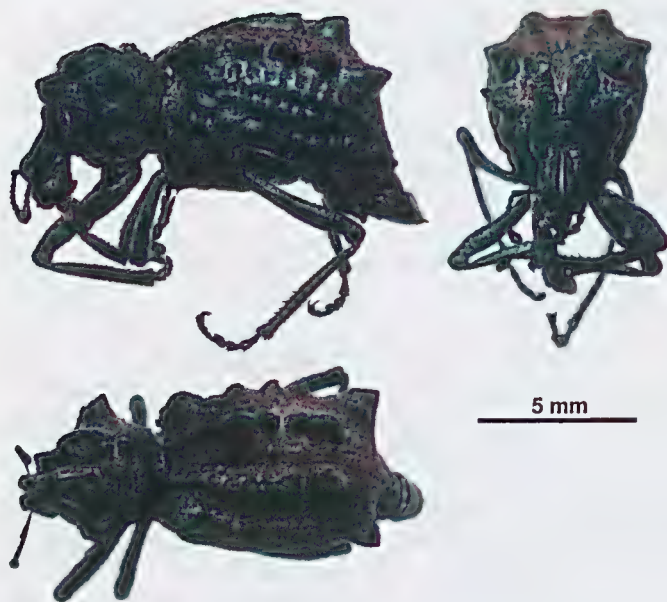


Fig. 1. Ventral, frontal and oblique dorsal views of a specimen of *Tetralophus sculpturatus* Waterhouse, collected 3.1 km WNW of Driffield, Victoria (deposited in the Australian National Insect Collection).

Tetralophus has a relatively narrow Bassian distribution, including southeastern South Australia, Victoria, southern New South Wales (Green Cape, Sydney) and Tasmania (Flinders Island). Figure 2 shows the distribution of *Tetralophus* as based on material in the Museum of Victoria (Melbourne) and the Australian National Insect Collection (Canberra), as well as on records in Zimmerman (1993) and by the author.

Observations

All new records are from remnant dry sclerophyll forest near the junction of Vary's Track and Golden Gully Road, 3.1 km WNW of Driffield, Victoria (ca 38°15'52"S, 146°17'56"E, alt. 110 m). The voucher specimens deposited in the Australian National Insect Collection and the Museum of Victoria readily conform to the illustration of *T. sculpturatus* provided by Zimmermann (1993) and other examined material.

The first observation of this host association reported here (by N. Porch and R. Porch), on 1 August 1998, was of an individual that had ascended a 20 cm long *Thelymitra* leaf about three-quarters of its length from the ground and was feeding on one margin of the leaf when it was collected. The second observation (by R. Porch), made on 6 October 2000, was of an individual

found feeding on a *Thelymitra* stem. It had apparently consumed about 40% of the stem, presumably by feeding from its tip and reversing down the stem as it fed. This method of feeding makes these weevils rather conspicuous in open forest as they cling to the leaf or stem as it waves precariously about. The third observation (by R. Porch) occurred on 7 October 2001, and the fourth, most recent one (by R. Porch) on 10 September 2005; both of weevils retreating down a *Thelymitra* leaf as they consumed it. All four observations were made between 10h00 and 16h00, suggesting that these weevils are diurnal, an unusual habit that was previously noted for some other members of the subfamily (Howden 1986).

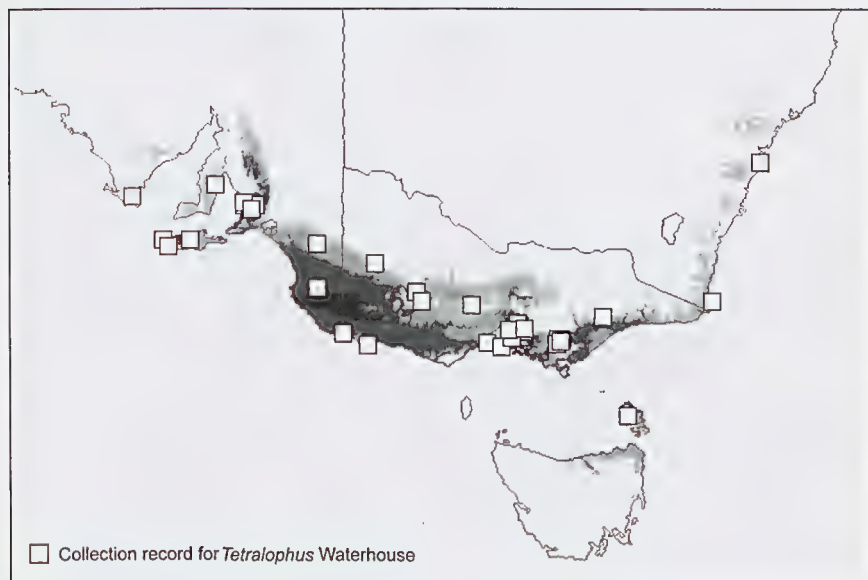


Fig. 2. Distribution records for *Tetralophus* Waterhouse and prediction of areas that are bioclimatically suitable, based on the BIOCLIM modeling function of BioLink (Shattuck and Fitzsimmons 2002). Prediction used annual and seasonal temperature layers, annual precipitation and an additional custom layer of warm season rainfall (precipitation of the warmest quarter); darker areas indicate climate types similar to the majority of distribution records, lighter areas indicate climates at the margins of the bioclimatic envelope for the genus where there are fewer collection records.

Discussion

Although larvae of this species were not located (a search would probably impact on the local *Thelymitra* population considerably), it is likely that they feed and develop within the orchid tubers or, alternatively, feed on the underground stem of the plant. May (1994) noted that 'all amycterine larvae

found so far are, with one exception, soil dwellers, living free and feeding on roots, or entering tubers, bulblets and corms of plants'; the exception being a species of *Acantholophus* Boisduval that feeds in the crowns of *Xanthorrhoea*.

It would be interesting to know whether *Tetralophus sculpturatus* is restricted in its host range to sun orchids or also feeds on other orchid genera, and whether the other *Tetralophus* species, *T. excursus* Pascoe, has similar habits. Further, given the widespread occurrence of *Thelymitra* and other succulent-leaved terrestrial orchid genera (such as *Calochilus*, *Prasophyllum* and *Microtis*) across the southern and eastern parts of the Australian continent, it is surprising that *Tetralophus* is not also more widespread. It is possible that elsewhere in the range of these orchid taxa, especially in southwestern Australia, other genera of small amycerines may feed on them in a similar way.

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A RECORD OF *DANAUS CHRYSIPPUS CRATIPPUS* (C. FELDER) (LEPIDOPTERA: NYMPHALIDAE: DANAINAE) FROM THURSDAY ISLAND, TORRES STRAIT

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Abstract

A female specimen of *Danaus chrysippus cratippus* (C. Felder) is recorded from Thursday Island, Torres Strait, Queensland. This constitutes the second known specimen of this taxon from Australia and the first record for Queensland. Due to the paucity of reference material of *D. petilia* (Stoll) from Torres Strait, it is unclear whether this specimen of *D. c. cratippus* is a vagrant or constitutes part of a natural sympatric distribution with *D. petilia* in northern Australia. The known distribution of *D. petilia* in Torres Strait, based primarily on observation records, is provided and encompasses almost all inhabited islands. Based on these records its temporal distribution in Torres Strait appears irregular, perhaps reflecting its dispersive and nomadic movements among the islands.

Introduction

The predominately Australian species *Danaus petilia* (Stoll) [originally described as *Papilio petilia* Stoll], has recently been reinstated to its former specific rank by Lushai *et al.* (2005). In Australia, *D. petilia* was considered specifically distinct by all early major butterfly workers, *e.g.* Masters (1873), Olliff (1889), Miskin (1891), Waterhouse (1903) and Rainbow (1907), until Waterhouse and Lyell (1914) incorporated it into the Old World species *Danaus chrysippus* (L.). Since then, all major Australian butterfly references to this species (Waterhouse 1932, Common 1964, Common and Waterhouse 1972, 1981, Zalucki 1999, Braby 2000) concurred with Waterhouse and Lyell (1914), including Talbot (1943) in his review of *Danaus* Kluk (Lushai *et al.* 2005). All concluded that *D. c. petilia* was the most easterly occurring subspecies of *D. chrysippus*, although Zalucki (1999) had suggested that *D. c. petilia* could be given specific status.

Although primarily Australian, *D. petilia* does occur infrequently in neighbouring areas (Lushai *et al.* 2005). Ackery and Vane-Wright (1984) reported it as uncommon in New Guinea, including its eastern islands and in the region west of the New Guinea mainland (Lushai *et al.* 2005). Parsons (1999) also considered it uncommon and local in Papua New Guinea with an occasional record from the Moluccas, west of New Guinea. Further east it is an uncommon visitor to the Solomon Islands, Vanuatu, New Caledonia and New Zealand (Ackery and Vane-Wright 1984, Tennent 2002). Small numbers of specimens of *D. petilia* are also known from Christmas and Cocos (Keeling) Islands in the Indian Ocean (Ackery and Vane-Wright 1984). The closest area to Australia where true *D. chrysippus* is known is eastern Indonesia where, from the Moluccas to Timor, Tanimbar and the Aru Islands, the species is referable to *D. c. cratippus* (C. Felder) (Braby 2000,

Lushai *et al.* 2005). *D. chrysippus* is highly dispersive and therefore it is not surprising that scattered records of *D. c. cratippus* are known from New Guinea and Australia (Ackery and Vane-Wright 1984, Braby 2000).

In Australia, *D. chrysippus* is currently known from only two specimens: a female attributed to 'form *dorippus*' allegedly from Roebourne, Western Australia and housed in The Natural History Museum, London (Talbot 1943, Common and Waterhouse 1981, Braby 2000) [typical *D. c. dorippus* (Klug) is from East Africa (Lushai *et al.* 2005) but the 'form' is widespread]; and a male *D. c. cratippus* in the Australian National Insect Collection from Cobourg Peninsula, Northern Territory, collected in January 1977 (Common and Waterhouse 1981, Braby 2000). In this paper the discovery of an additional specimen of *D. c. cratippus* is reported, collected flying on the edge of monsoon vine forest at the western end of Thursday I., Torres Strait.

Abbreviations used for observation and collection records are: AIK – A.I. Knight; AM – Australian Museum, Sydney; CGM – C.G. Miller; JWT – J.W. Turner (ex DPIF, Qld); KH – K. Houston (ex DPIF, Qld); PSV – P.S. Valentine; SJJ – S.J. Johnson; TAL – T.A. Lambkin; TLIKC – joint collection of T.A. Lambkin and A.I. Knight, Brisbane; UQ – University of Queensland, St Lucia, Brisbane.

Danaus chrysippus cratippus (C. Felder)

(Fig. 1)

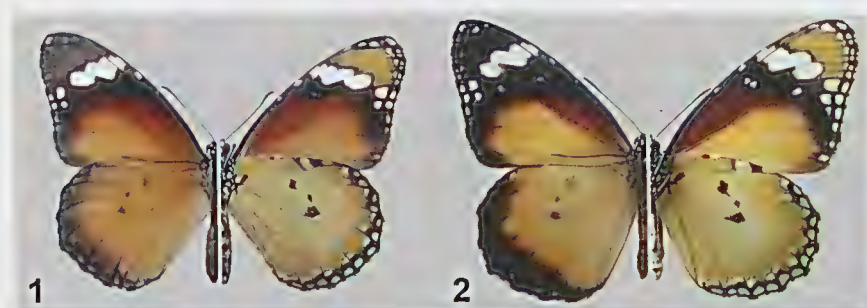
Material examined. QUEENSLAND (TORRES STRAIT): 1 ♀, Green Hill, Thursday Island, 25.iv.1995, TAL (TLIKC).

Discussion. During a recent examination of specimens referred to *D. petilia* in the author's collection, it was noted that the external facies of a female specimen collected from Thursday Island, Torres Strait (Fig. 1), generally matched [except in size] that of *D. c. cratippus* as outlined in Lushai *et al.* (2005) and verified by M.P. Zalucki and G. Daniels (UQ).

Despite Braby's (2000) indication that *D. petilia* (Fig. 2) is common in the Australian tropics and the many records of sightings on almost all inhabited Torres Strait islands, there are few Torres Strait specimens known in collections. This is most likely the result of a general neglect of this species by butterfly collectors, due to its general commonness in Australia.

Currently in Torres Strait what is believed to be *D. petilia* has been observed at various times on almost all inhabited islands: in the north of the strait on Boigu, Dauan and Saibai Islands; in the east on Darnley and Murray; in the central region on Badu, Moa and Yam; and in the south on Hammond, Horn, Prince of Wales and Thursday Islands (Mathew 1885, De Baar 1988, Talbot 1943, Valentine and Johnson 1993, observation and collection records of AIK, AM, CGM, JWT, KH, SJJ, PSV and TAL). In addition, the temporal records of *D. petilia* on almost all Torres Strait islands appear irregular,

perhaps reflecting its dispersive and nomadic movements among the islands (Tennent 2002, Lushai *et al.* 2005).



Figs 1-2. *Danaus* spp. Both figures to scale, upperside left, underside right [forewing lengths in parentheses]. (1) *D. chrysippus cratippus*, female: Green Hill, Thursday Island, Torres Strait, Qld, 25.iv.1995, TAL [35 mm]; (2) *D. petilia*, female: Jamboree Heights, Brisbane, Qld, 20.ix.1980, TAL [38 mm].

Taking into account that larval host plants of *D. petilia* are not often observed on many of the Torres Strait islands (TAL unpublished data), its irregular occurrence on these islands might reflect local introductions and extinctions of the host plant and the butterfly. Therefore, due to the paucity of Torres Strait material available for examination, it is unclear whether the specimen of *D. c. cratippus* reported here is an isolated vagrant to Torres Strait or represents part of a natural sympatric distribution with *D. petilia* in northern Australia. Certainly, more intensive collecting of *D. petilia* and its congeners in the tropical areas of Australia would be rewarding in supplementing the current knowledge of their distributions in Australia.

Acknowledgements

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A NEW SPECIES AND NOMENCLATURAL CHANGES IN THE SUBGENUS *POLYRHACHIS* (*CYRTOMYRMA*) FOREL (HYMENOPTERA: FORMICIDAE: FORMICINAE)

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Abstract

Polyrhachis dorowi sp. n., a new species of the subgenus *Cyrtomyrma* Forel from Cape York Peninsula, Queensland, is described and illustrated. *Polyrhachis busiris* Fr. Smith, 1860, from New Guinea, is removed from synonymy with *P. rastellata* (Latreille, 1802), redescribed and reinstated as a valid species; a lectotype is also designated. *Polyrhachis rastellata baduri* Donisthorpe, 1941, from Japen Island off the northwestern coast of Irian Jaya [= West Papua], Indonesia, is considered a new synonym of *P. euryala* Fr. Smith, 1863. The occurrence of *P. debilis* Emery in Australia, earlier considered doubtful, is now confirmed by specimens from Melville Island, off the coast of the Northern Territory.

Introduction

During a recent examination of *Cyrtomyrma* Forel material from Cape York Peninsula, Queensland, I come upon several colonies of an apparently undescribed species. This species has a highly arched mesosoma and somewhat resembles a number of recently described Australasian species, notably *Polyrhachis robsoni* Kohout from Queensland and *P. hybosa* Kohout and *P. tuberosa* Kohout from New Guinea (see Kohout 2006). However, the new species differs from *P. robsoni* in having the pronotal shoulders widely rounded, while they are toothed or angular in the latter. From *P. hybosa* and *P. tuberosa* the new species differs by its generally smaller size and the form of the mesosoma, which is shorter, more slender and steeply descends from the summit towards the propodeal declivity. I consider that the characters separating these taxa warrant the description of the above specimens from Cape York Peninsula as a new species.

On a recent visit to the Oxford University Museum of Natural History (OXUM), I located both syntypes of *P. busiris* Fr. Smith listed by Smith (1860: 98) in his original description of the species. The specimens were placed in the Museum's general collection, not with the other type material of species collected by Alfred Russell Wallace and described by Frederick Smith. This is probably why the syntypes of *P. busiris* remained virtually unknown and were apparently missed by later researchers.

Publication dates and the spelling of species epithets and authors' names follow Bolton (1995) and Dorow (1995). Original collecting localities were checked against the Bishop Museum's unpublished list of New Guinea localities, produced in 1966. In some cases the latitude and longitude coordinates are only roughly approximate. The use of the words 'New Guinea' or 'Moluccas' alone indicates the delimitation of these regions in a biogeographical sense, regardless of current political boundaries.

Methods

Photographs of the specimens were taken with a digital camera attached to a stereomicroscope and processed using Auto-Montage (Syncroscopy, Division of Synoptics Ltd, USA) and Adobe Photoshop CS2 (Adobe Systems Inc, USA). All digital images depict the primary types.

Standard Measurements and Indices: TL = Total length (the necessarily composite measurement of the outstretched length of the entire ant measured in profile); HL = Head length (the maximum measurable length of the head in perfect full face view, measured from the anterior-most point of the clypeal border or teeth, to the posterior-most point of the preoccipital margin); HW = Head width (width of the head in perfect full face view, measured immediately in front of the eyes); CI = Cephalic index ($HW \times 100/HL$); SL = Scape length (excluding the condyle); SI = Scape index ($SL \times 100/HW$); PW = Pronotal width (maximum width of the pronotal dorsum excluding the spines); MTL = Metathoracic tibial length (maximum measurable length of the tibia of the hind leg). Measurements were taken using a Zeiss SR stereomicroscope at 32x magnification with an eyepiece graticule calibrated against a stage micrometer. All measurements are in millimetres (mm).

Abbreviations used for specimen data are: acc. = accession; for. = forest; q = queen; R. = River; RJK = R.J. Kohout; rf. = rainforest; w = worker/s; WHOD = Wolfgang H.O. Dorow.

Abbreviations used for Institutions (with names of cooperating curators) are: AMNH – American Museum of Natural History, New York, NY, USA (Dr J.M. Carpenter); ANIC – Australian National Insect Collection, CSIRO Entomology, Canberra, ACT, Australia (Drs S.O. Shattuck, R.W. Taylor); BMNH – The Natural History Museum, London, UK (Dr Barry Bolton, K. Goodger); BPBM – Bernice P. Bishop Museum, Honolulu, HI, USA (K.T. Arakaki); CASC – California Academy of Sciences, San Francisco, CA, USA (Dr B.L. Fisher); JWGU – Johan Wolfgang Goethe-Universität, Frankfurt am Main, Germany (Prof. Dr U. Maschwitz); MCZC – Museum of Comparative Zoology, Harvard University, Cambridge, MA, USA (Dr S.P. Cover); MHNG – Muséum d'Histoire Naturelle, Geneva, Switzerland (Drs C. Besuchet, I. Löbl, B. Merz); MNHA – Museum of Nature and Human Activities, Sanda, Hyogo, Japan (Dr Yoshiaki Hashimoto); MNHU – Museum für Naturkunde, Humboldt-Universität, Berlin, Germany (Dr F. Koch); NHMW – Naturhistorisches Museum, Vienna, Austria (Drs M. Fisher, S. Schödl, H. Zettel); NMNH – National Museum of Natural History, Smithsonian Institution, Washington, DC, USA (Dr T.R. Schultz); OXUM – Hope Entomological Collections, University Museum, Oxford, UK (Dr D.J. Mann); QMBA – Queensland Museum, Brisbane, Qld, Australia (Drs C.J. Burwell, G.B. Monteith); SMFG – Forschungsinstitut Senckenberg, Frankfurt am Main, Germany (Dr W.H.O. Dorow); SNSD – Staatliche Naturhistorische Sammlungen, Museum für Tierkunde, Dresden, Germany

(Drs R. Emmrich, U. Kallweit); TERC – Tropical Ecosystems Research Centre, CSIRO, Darwin, NT, Australia (Dr A.N. Andersen).

Systematics

Polyrhachis dorowi sp. n.

(Figs 1, 4-5)

Types. *Holotype* worker, AUSTRALIA (QUEENSLAND): Cape York Peninsula, Lockerbie Scrub, 10°46'S, 142°29'E, 23-26.ix.2003, lowland rf., ex nest between leaves, W.H.O. Dorow (RJK acc. 03.10). *Paratypes*: 55 workers, same data as holotype; 29 workers, 5 ♀♀, 9 ♂♂, same data as holotype except 19-23.iii.1987 (RJK accs 87.36, 37, 44, 51, 66, 68). *Holotype* (QMT 152066) and most paratypes in QMBA; 3 paratype workers and paratype ♀ in ANIC; 2 paratype workers each in BMNH, CASC, MCZC, MHNG, MNHU, NHMW, NMNH and SMFG.

Additional material examined. AUSTRALIA (QUEENSLAND): Cape York Peninsula, Bamaga, 10°53'S, 142°23'E, 26.ix.2003, riparian rf., (RJK acc. 03.19) (w).

Description. Worker. Dimensions (holotype cited first): TL *c.* 6.00, 5.14-6.25; HL 1.53, 1.34-1.56; HW 1.50, 1.22-1.53; CI 98, 91-98; SL 1.87, 1.65-1.93; SI 125, 124-135; PW 1.18, 1.03-1.25; MTL 2.15, 1.84-2.18 (24 measured). Mandibles with five teeth. Anterior clypeal margin with truncate, medially notched central flange, laterally flanked by acute denticles. Clypeus in profile straight or very weakly convex, posteriorly rounding into moderately impressed basal margin. Frontal triangle weakly indicated. Frontal carinae sinuate with margins moderately raised at mid-length, rather flat anteriorly and posteriorly; central area with moderately impressed frontal furrow. Sides of head in front of eyes weakly convex towards mandibular bases; behind eyes rounding into moderately convex occipital margin. Eyes relatively large, convex, in full-face view clearly breaking lateral cephalic outline. Ocelli lacking. Pronotum in lateral view with anterior face rising very steeply towards narrow summit situated in front of strongly impressed promesonotal suture. Pronotal humeri in dorsal view rounded with greatest width of pronotum just before mid-length of segment. Mesosomal dorsum steeply descending towards propodeal declivity; metanotal groove lacking. Petiole relatively low, virtually triangular in lateral view with anterior and posterior faces weakly convex; dorsal margin armed with four spines, dorsal pair short, close together and broad-based, lateral pair diverging, slender and more acute. Subpetiolar process acute anteriorly, narrowly rounded posteriorly. Anterior face of first gastral segment about as high as full height of petiole, widely rounding onto dorsum of gaster.

Mandibles very finely, longitudinally striate with numerous piliferous pits. Dorsum of head, mesosoma and gaster finely shagreened. Intensity of mesosomal sculpturation distinctly increasing laterally with lower portions of pronotum, meso- and metapleurae rather strongly reticulate-rugose. Petiole mostly transversely wrinkled dorsally, becoming reticulate-rugose near base.

Mandibular masticatory borders with numerous curved hairs. Anterior clypeal margin medially with a few golden setae and several shorter setae fringing margin laterally. A few pairs of longer hairs arising near anterior and basal clypeal margins, along frontal carinae, on vertex and anterior face of frontal coxae. Tuft of long, variously curved hairs, not exceeding greatest diameter of eye in length, situated on summit of mesonotum. Numerous, distinctly shorter hairs arising along margins of segments and around apex of gaster.

Black; mandibular teeth, extreme tip of apical antennal segment and most of legs reddish-brown; proximal part of tibiae and tarsi black.

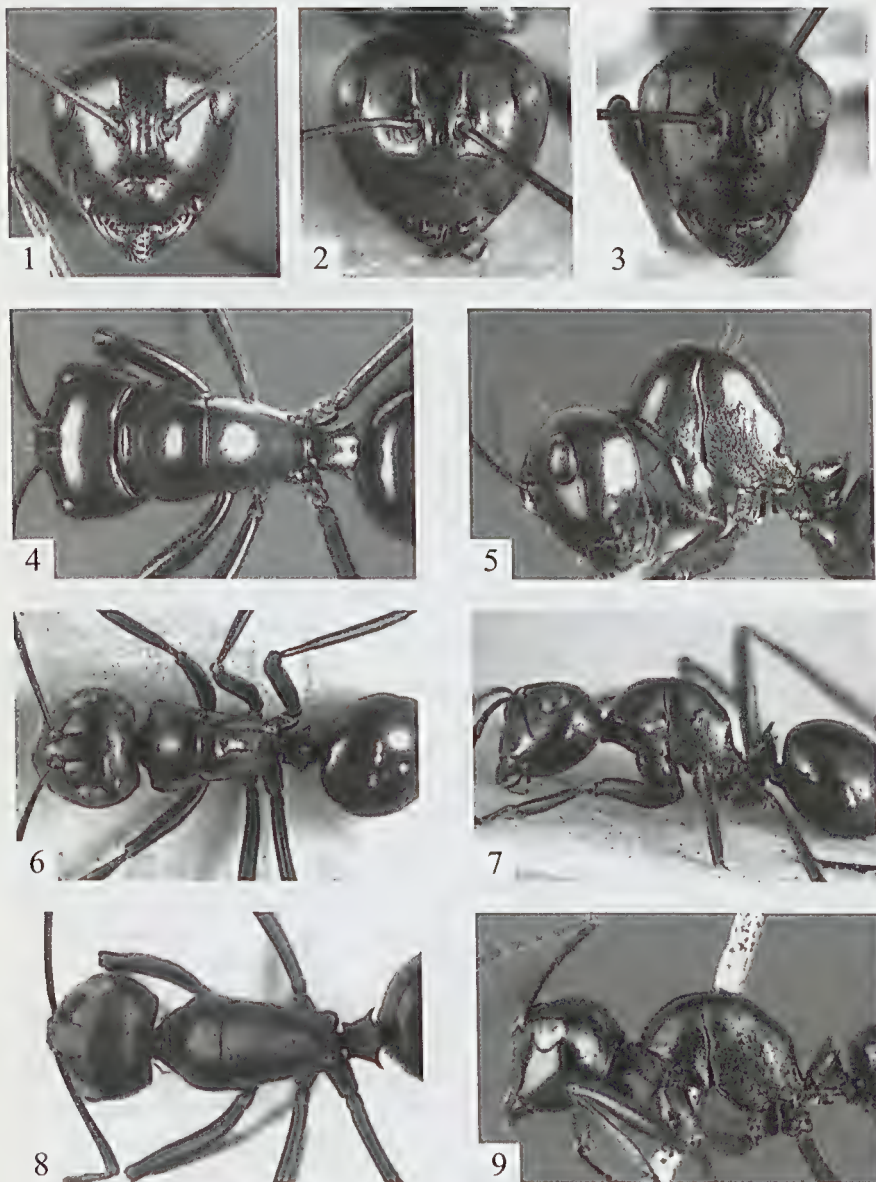
Queen. Dimensions: TL *c.* 7.51-8.01; HL 1.72-1.81; HW 1.53-1.64; CI 88-91; SL 2.00-2.12; SI 122-133; PW 1.68-1.84; MTL 2.37-2.59 (5 measured). Closely resembling worker and apart of sexual characters differing as follows: eyes only moderately convex, in full face view just breaking lateral cephalic outline; pronotal humeri subangular; mesoscutum in dorsal view wider than long with lateral margins converging anteriorly into broadly rounded anterior margin; median line bifurcate dorsally. In lateral view mesoscutum relatively high with anterior margin widely rounding onto flat dorsum; parapsides rather flat anteriorly, weakly raised posteriorly; mesoscutellum in profile weakly convex, moderately elevated above dorsum of mesosoma; metanotal groove distinct; propodeum with rudimentary tubercles; propodeal dorsum convex in profile evenly descending into vertical declivity. Body sculpturation, pilosity and colour as in worker.

Males and immature stages (eggs, larvae and pupae) deposited in the QMBA spirit collection.

Etymology. After the collector of the type series, Dr Wolfgang H.O. Dorow of the Senckenberg Institute, Frankfurt am Main, Germany.

Remarks. *Polyrhachis dorowi* is characterised by the highly arched mesosoma and steeply rising anterior face of pronotal dorsum with its summit just before the promesonotal suture. It can be identified by the following modification to the key to Australian species in Kohout (2006). Figure numbers in square brackets refer to illustrations in the original article (Kohout 2006).

- 15 Antennal scapes longer (SI >140); lateral petiolar spines longer than dorsal pair (Fig. 8) (Indonesia, New Guinea) *P. euryala* Fr. Smith
- Antennal scapes shorter (SI <135); lateral and dorsal petiolar spines subequal in length 16
- 16 Pronotum in dorsal view strongly transverse, humeri bluntly angular or narrowly rounded; petiole with sides only weakly diverging dorsally (mid- to southern Queensland) [Fig. 4 C-D] *P. mackayi* Donisthorpe



Figs 1-9. *Polyrhachis dorowi* sp. n., holotype worker: (1) head in full-face view; (4) dorsal view; (5) lateral view. *Polyrhachis busiris* Fr. Smith, lectotype worker: (2) head in full-face view; (6) dorsal view; (7) lateral view. *Polyrhachis euryala* Fr. Smith, syntype worker: (3) head in full-face view; (8) dorsal view; (9) lateral view.

- Pronotum in dorsal view only weakly transverse, humeri widely rounded; petiole with sides more strongly diverging dorsally (far northern Queensland) 17
- 17 Mesosoma in lateral view more-or-less evenly rounded with very steep, almost vertical propodeal declivity [Fig. 2 A, D-E] ... *P. delecta* Kohout
- Mesosoma in lateral view highly arched with anterior face of pronotum steeply rising towards narrow summit; mesonotal and propodeal dorsa steeply descending posteriorly towards oblique declivity (Fig. 5)
..... *P. dorowi* sp. n.

***Polyrhachis busiris* Fr. Smith, 1860, stat. rev.**

(Figs 2, 6-7)

Polyrhachis busiris Fr. Smith, 1860: 98, pl. 1, fig. 15. Syntype workers (2). Original localities: NEW GUINEA, Dory (= IRIAN JAYA, Manokwari) (A.R. Wallace); INDONESIA, Batjan I. (A.R. Wallace), OXUM (examined).

Polyrhachis busiris Fr. Smith; Mayr, 1862: 688. Junior synonym of *rastellata* (Latreille, 1802).

Additional material examined. INDONESIA (IRIAN JAYA [= WEST PAPUA]): Baitenissa, Gesa R., 02.09°S, 137.43°E, ~20 m, 6-12.v.2007, lowland swamp for., ex carton nest on tree trunk (R.R. Snelling # 07-052) (w).

Lectotype designation. Both syntypes of *P. busiris* are card mounted and in relatively good condition. In addition to BMNH blue disc 'Syntype' tags, they are both furnished with Hope Department, Oxford labels inscribed '*Polyrachis* (sic) *busiris* Smith', one with 1179¹/₂ and the other with 1179²/₂. The latter specimen also bears a round, white disc inscribed 'Dor.' (= Dory) and an apparently original, handwritten label inscribed '*Polyrhachis Busiris* Smith'. Its petiole matches the figure given in the original article (Smith 1860: pl. 1, fig. 15) and, in order to maintain nomenclatural stability and preserve current usage, this specimen is here designated the lectotype of *P. busiris* Fr. Smith. The other specimen, which bears a round disc inscribed 'Bac.' (= Bachian; = Batjan I.), is deemed a paralectotype. This is the specimen that was apparently examined by Donisthorpe and furnished with two additional labels referring to the citation of this species in his paper on Smith's types (Donisthorpe 1932: 460). However, closer examination reveals that the paralectotype is not conspecific with the lectotype. It clearly represents a different species that is very similar to *Polyrhachis fornicata* Emery (see Kohout 2008) and most likely represents a Moluccan population of that species.

Redescription. Worker: Dimensions (lectotype cited first): TL c. 6.80, 6.40-7.06; HL 1.78, 1.65-1.78; HW 1.84, 1.62-1.84; CI 103, 96-103; SL 2.15, 2.00-2.15; SI 117, 117-123; PW 1.43, 1.31-1.43; MTL 2.59, 2.43-2.62 (19 measured).

Head, excluding mandibles, about as long as wide. Mandibles with five teeth, apical tooth largest with subsequent teeth reducing in length towards base. Anterior clypeal margin with central truncate flange, shallowly notched medially and flanked laterally by acute denticles. Clypeus in profile weakly convex with basal margin moderately impressed. Frontal triangle poorly indicated. Frontal carinae sinuate with only weakly raised margins; frontal furrow shallowly impressed. Sides of head in front of eyes strongly converging towards mandibular bases; behind eyes widely rounding into weakly convex occipital margin. Eyes moderately convex; in full face view not or just touching lateral cephalic outline. Ocelli lacking. Pronotum in dorsal view distinctly transverse with humeri angular or toothed. Mesosoma in profile more-or-less evenly convex; promesonotal suture distinct, metanotal groove lacking. Propodeum armed with distinct tuberculae or short teeth; declivity oblique. Petiole with anterior face straight, posterior face convex; dorsum armed with four, subequal, acute spines. Anterior face of first gastral segment lower than full height of petiole, widely rounding onto dorsum of segment.

Mandibles very finely and closely, mostly longitudinally, striate. Head, mesosoma and gaster finely shagreened. Intensity of sculpturation increasing laterally with sides of mesosoma distinctly reticulate and meso- and metapleurae rather strongly reticulate-rugose. Petiole finely, mostly transversely, reticulate dorsally, becoming reticulate-rugose around base.

Mandibles with numerous straight or weakly curved golden hairs arising near masticatory borders and numerous very short appressed hairs towards mandibular bases. Anterior clypeal margin with a few long, anteriorly directed, golden setae and several short setae fringing margin laterally. A few pairs of medium length, erect hairs arising near anterior and basal clypeal margins, along frontal carinae and on vertex. Several medium to long, mostly erect or somewhat curved hairs on front coxae, ventral surfaces of trochanters and apical segments of gaster. Tuft of a few semierect hairs on summit of mesonotum, with longest hairs reaching about half of greatest diameter of eye in length. Very short, closely appressed pubescence in various densities over most body surfaces.

Black throughout; joints of trochanters and femora and distal half of tibiae in modern specimens medium to dark reddish-brown.

Sexuals and immature stages unknown.

Remarks. Mayr (1862) considered *Polyrhachis busiris* to be a synonym of *P. rastellata* and his opinion was accepted by all subsequent authors, including Roger (1863), Dalla Torre (1893), Emery (1925), Donisthorpe (1932) and, more recently, Than (1978), Dorow (1995) and Bolton (1995). I examined and compared both *P. busiris* types with specimens interpreted earlier as *P. rastellata* (see Kohout 2006: 115) and believe that Mayr suggested this

synonymy without seeing the actual specimens. I consider his action to be incorrect and am confident in reinstating *P. busiris* to full specific status.

Polyrhachis busiris is similar to a number of New Guinean species that also feature distinctly angular or toothed pronotal humeri and a propodeal dorsum armed with spines, teeth or tuberculae. It can be distinguished by using the following key in addition to that in Kohout (2006).

- 1 Pronotal humeri in dorsal view produced into prominent teeth or bilobed 2
- Pronotal humeri distinctly angular or narrowly rounded 3
- 2 Propodeal spines long, dorsoventrally compressed, widely diverging and bluntly terminated (Aru Is) *P. levior* Roger
- Propodeal spines very short, strongly upturned and acute *P. albertisi* Emery
- 3 Propodeum armed with a pair of distinct spines 4
- Propodeum armed with a pair of more-or-less distinct tuberculae *P. busiris* Fr. Smith
- 4 Propodeal spines long, dorsoventrally compressed, widely diverging and bluntly terminated; lateral petiolar spines distinctly elongated *P. barryi* Kohout
- Propodeal spines short, acute, strongly upturned; petiolar spines more-or-less subequal 5
- 5 Larger species (HL > 1.68); anterior face of pronotal dorsum in profile strongly convex; pronotal humeri narrowly rounded *P. lineae* Donisthorpe
- Smaller species (HL < 1.56); pronotal dorsum in profile only weakly convex towards distinctly impressed promesonotal suture; pronotal humeri distinctly angular *P. mondoui* Donisthorpe

***Polyrhachis euryala* Fr. Smith, 1863**

(Figs 3, 8-9)

Polyrhachis euryalus Fr. Smith, 1863: 17. Syntype workers. Type locality: INDONESIA, Misool I. (A.R. Wallace), OXUM, BMNH (examined).

Polyrhachis euryalus Fr. Smith; Mayr, 1872: 138. Junior synonym of *P. rastellata* (Latreille, 1802).

Polyrhachis rastellata var. *euryalus* Fr. Smith; Emery, 1900: 720. Revived from synonymy as a variety of *P. rastellata* (Latreille, 1802).

Polyrhachis rastellata var. *torricelliana* Viehmeyer, 1912: 9, fig. 11. Syntype workers. Type locality: NEW GUINEA, Torricelli Mts ('Kais. Wilhelmsland, Toricelli Gebirge' on data label) (Schlaginhaufen), SNSD (examined). Synonymy by Viehmeyer, 1914: 50.

Polyrhachis (Cyrtomyrma) rastellata ssp. *euryalus* Fr. Smith; Emery, 1925: 208. Subspecies of *P. rastellata* (Latreille, 1802) and combination in *P. (Cyrtomyrma)*.

Polyrhachis (Cyrtomyrma) euryalus Fr. Smith; Donisthorpe, 1938: 259. Revived status as species.

Polyrhachis (Cyrtomyrma) rastellata var. *baduri* Donisthorpe, 1941: 63. Syntype workers, queen. Type locality: NEW GUINEA ('Dutch New Guinea' on data label), Japen I., Mt Baduri, 1,000 ft. viii.1938 (L.E. Cheesman B.M. 1938-593), BMNH, CASC, MCZC, QMBA (examined). Syn. n.

Additional material examined. INDONESIA (IRIAN JAYA [= WEST PAPUA]): Waris, S of Hollandia, 450-500 m, 1-7.viii.1959 (T.C. Maa) (w). PAPUA NEW GUINEA: 2 km E of Maprik, 03°38'S, 143°04'E, 200 m, 10.ii.1989 (P.S. Ward # 10165-8) (w); 1-2 km S of Pes Mission, c. 12 km WSW of Aitape, 03°11'S, 142°15'E, <50 m, 31.vii-3.viii.1984 (RJK acc. 84.172) (w, ♀).

Dimensions of *euryala* syntypes: TL c. 6.25-7.00; HL 1.53-1.56; HW 1.43; CI 92-93; SL 2.03-2.06; SI 142-144; PW 1.15; MTL 2.50 (2 measured).

Dimensions of *rastellata baduri* syntypes: TL c. 6.20-6.55; HL 1.59-1.65; HW 1.56-1.59; CI 94-100; SL 2.15-2.18; SI 135-140; PW 1.18-1.22; MTL 2.59-2.68 (2 measured).

Dimensions of *rastellata torricelliana* syntypes: TL c. 5.14-6.00; HL 1.43-1.50; HW 1.31-1.43; CI 92-95; SL 1.81-1.96; SI 137-138; PW 1.11-1.22; MTL 2.03-2.34 (2 measured).

Remarks. I have examined two syntypes each of *P. euryala* (OXUM, BMNH), *P. rastellata torricelliana* (SNSD) and *P. rastellata baduri* (BMNH, MCZC) and consider that they represent only different populations of a single species. All three taxa are characterised by widely rounded shoulders with the pronotal dorsum widest at around its mid-length. They differ somewhat in the outline of the petiole, with the lateral spines in *P. euryala* being more acute and longer than the dorsal pair, while in *P. rastellata torricelliana* and *P. rastellata baduri* the petiolar spines are more-or-less subequal and the lateral pair less divergent. However, examination of the additional material listed above reveals some variability in the length of the petiolar spines between different populations and I am confident that all three names represent a single biological species. Kohout (2006: 98) noted that *P. euryala* closely resembled *P. delecta* Kohout from Australia, sharing a distinctly slender mesosoma with widely rounded shoulders. However, they differ in the length of the antennal scapes, which are markedly shorter in *P. delecta* (SL 119-129) compared with those in *P. euryala* (SL 137-144). *Polyrhachis rastellata baduri* was erroneously omitted from my recent review of the New Guinean *Cyrtomyrma* species (Kohout 2006).

One of the three available syntypes of *P. rastellata torricelliana* is in fact a specimen of *P. wagneri* Viehmeyer, 1914; it closely matches most of the available syntypes (MNHU) of that species. Although Viehmeyer (1914)

listed only one specimen in the original description of *P. wagneri*, there are actually four available specimens labelled as types. However, on closer examination, one of the four also represents a second species and matches the types of *P. rastellata torricelliana*. Because Viehmeyer (1914) described *P. wagneri* in the same paper in which he synonymised *P. rastellata torricelliana* with *P. euryala*, I believe it is possible that some specimens of both species were accidentally mixed and mislabelled during their examination. *Polyrhachis wagneri* and *P. rastellata torricelliana* are very similar, with both featuring distinctly rounded pronotal shoulders. They differ in size (HL 1.65-1.68 in *P. wagneri* versus HL 1.43-1.50 in *P. rastellata torricelliana*) and in the shape of the petiole, which is exceptionally broad and with widely diverging lateral spines in *P. wagneri*. The propodeal dorsum in *P. wagneri* also bears a pair of very short, tooth-like spines or tubercles that are completely absent in *P. rastellata torricelliana*.

A newly confirmed Australian record

In my paper on the *Polyrhachis* and *Echinopla* ants of Queensland's Wet Tropics (Kohout 2000), I suggested that *P. debilis* Emery occurred in Australia. However, further study of the Queensland specimens originally thought to belong to that species confirmed their identity as *P. yorkana* Forel (Kohout 2006: 91). In the latter paper I also noted specimens similar to *P. debilis* that originated from Melville Island off the coast of the Northern Territory. As only a few specimens were available at that time and their relationship with *P. debilis* was inconclusive, they were considered to probably represent a new species. However, recent collecting on Melville Island by Dr Alan N. Andersen (TERC) produced sufficient material to allow a more detailed comparison with several available syntypes of *P. debilis*. Apart from some rather trivial differences, the two groups of specimens are very similar and, as a result, I consider the Melville Island specimens to represent an isolated population of *P. debilis*.

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